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Table of Contents	1 - 6	60	06/04/97	1 - 6	61	06/19/97
Section 3.25, "Data Validation for High Level RCRA/CERCLA Radiochemical Analyses"	--	-	--	1 - 20	0	06/19/97
Section 9.7, "222-S Equipment and Piping Labeling"	--	-	--	1 - 30	0	06/19/97

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Data Validation for High Level RCRA/CERCLA Radiochemical Analyses

Approved by

J. E. Hyatt, Manager
Hanford Analytical Services

Author: K. N. Pool
Organization: Sample Management

1.0 PURPOSE

The purpose of this procedure is to define the process or methodology for validation of laboratory data packages to the sample delivery group (SDG), data quality objectives (DQO), and regulatory requirements applicable to high level (activity) RCRA/CERCLA radiochemical analytical data.

2.0 SCOPE

The scope of this procedure is the evaluation and validation of high level (activity) radiochemical analysis data packages presented in accordance with a Statement of Work (SOW), or Letter of Instruction (LOI) controlled by the Sample Management Office (SMO).

3.0 RESPONSIBILITIES

3.1 Manager, Sample Management Office

1. Ensures that SMO technical staff has the proper education, training, and experience to perform their designated tasks.

2. Maintains qualification records for SMO technical staff.

3.2 Technical Staff Member (Project Coordinator), SMO

1. Oversees assigned project

   - Including interface with cognizant technical representatives of the client organization

   - Including validation of data received from laboratories

4.0 RADIOCHEMICAL VALIDATION OVERVIEW

Data validation is the assessment that determines if the proper analyses were performed and recorded as defined by the SOW, LOI, or SDG DQOs, if the correct documentation is present to verify the controls in the laboratory were performed, and if the data is defensible to the requirements of the SOW, LOI, or SDG DQOs. Data validation is a systematic review of analytical data from samples and their associated laboratory quality control (QC) samples. The purpose of the review is to make determinations concerning data quality and data limitations in order to assist the user in avoiding inappropriate use of the data, while not precluding any consideration of the data at all. This is accomplished through documentation and the use of data qualifiers. The data qualifiers to be applied by the reviewer for the radiochemical procedures are found in Appendix A.

All data reviews covered by this procedure must have, as a cover sheet, the SMO High Level Radiochemical Data Validation form. This form is used to summarize specific areas checked and deficiencies requiring attention, as well as overall laboratory performance and any discernable trends in the quality of the data. Supplementary documentation must accompany the forms to clearly identify the problems associated with a single sample or an SDG and any resulting qualification of the data. This additional documentation is provided on the Radiochemical QC attachment pages, and along with the cover sheets are found in Appendices B through J. Specific documentation requirements are outlined in Section 5.0.

The SMO High Level (Activity) RCRA/CERCLA Radiochemical Data Validation Procedure is a review of laboratory performance and implementation of protocol. Subsequent technical data evaluation by project lead personnel shall include a determination of the appropriateness of results from a standpoint of past history and present knowledge of the sample site, as well as traceability and proper documentation, from cradle to grave. Any data failing to meet SDG quality control requirements will be documented and the data qualified using the guidelines of this procedure.

5.0 RADIOCHEMICAL PROCEDURE

The requirements to be reviewed during validation are listed below:

- Chain-of-custody
- Requested versus reported analyses
- Initial calibration
- Efficiency checks
- Background checks
- Preparation blanks
- Matrix spikes/tracers/carriers
- Duplicate analysis
- Laboratory control samples
- Other quality control.

The SMO High Level (Activity) RCRA/CERCLA Radiochemical Validation Procedure is heavily based on the EPA's Handbook for Analytical Quality Control in Radioanalytical Laboratories methodology and QC requirements (EPA 1977). The document may be a useful reference during the review process. Because of the limited requirements and guidelines that exist regarding the evaluation of radiochemical data, this procedure represents a conservative approach to qualification of the data. Because of the nature of sampling, laboratory analysis, matrix interferents, and other factors, problems may arise with data that are not specifically reviewed in this procedure. These anomalies will be clearly documented and qualified as directed in the SOW, LOI or in the SDG's DQOs.

5.1 Chain-of-Custody

The objective is to ensure that every step in the sampling and/or shipping process that might affect the validation process be documented.

5.1.1 Criteria

Specified sampling/shipping procedure steps noting deviations shall be documented on the Chain-of-Custody (COC), or supporting documentation as defined in Section 3.14, "Laboratory Sample Tracking."

5.1.2 Evaluation

Review the COC and supporting documentation to verify that all anomalies were documented.

5.1.3 Action

If anomalies or procedure deviations occurred in the sampling or shipping process, the affected sample data should be qualified as estimated (J) for positive results and (UJ) for non-detects (based on direction from the cognizant technical representative or on the SDG's DQOs).

5.2 Requested Versus Reported Analyses

The objective is to ensure that all analyses and associated QC data requested by the customer are reported by the laboratory.

5.2.1 Criteria

All requested analyses shall be reported or accounted for.

5.2.2 Evaluation

Review the Sample Analysis Request or COC and verify that all analyses were reported by the laboratory or accounted for in the case of any anomalies. A copy of the Sample Analysis Request or COC shall be attached to the validation documentation discussed in Section 6.0.

5.2.3 Action

Contact the laboratory and/or sampling team in the event of any unreported analyses and document the cause of the discrepancy. Make any necessary arrangements to run/rerun the missing analyses on existing samples as required by the customer. Should analysis reruns be impossible, arrangements should be made to resample as required by the customer.

5.3 Initial Calibration

Calibration requirements are established to ensure that an instrument is capable of producing acceptable quantitative data. Initial calibration data demonstrates that the instrument is capable of acceptable performance at the beginning of an analysis run. Efficiency or calibration verification checks are performed on a regular basis as specified in the instrument or method specific procedure, to ensure that acceptable performance is maintained throughout the run and on a day-to-day basis. Instrument efficiencies are also determined from the initial calibration.

5.3.1 Calibration

Analytical instrumentation shall be calibrated in accordance with requirements specific to the instrumentation and methods or procedures employed. Instrument calibration shall be performed after instrument maintenance, when check standards are outside the three standard deviation control limits or as specified in the instrument specific methods or procedures.

5.3.2 Evaluation

Review the initial calibration data and the analysis run log or raw data to verify that the calibration frequency requirements were met and that all results were within the method specified control limits.

5.3.3 Action

If the initial calibration QC criteria or the calibration frequency requirements were not met, qualify all associated positive sample results as estimated (J) and non-detects as estimated (UJ). Results may be qualified as unusable based on direction given by the cognizant technical representative or the SDG's DQOs. Results not meeting criteria and control limits applied must be clearly documented.

5.4 Efficiency Checks

Efficiency checks are established to ensure that an instrument is continuing to produce acceptable quantitative data.

5.4.1 Criteria

Efficiency checks for analytical instrumentation shall be in accordance with requirements specific to the instrumentation or designated in the Data Quality Objectives (DQOs). Control limits for efficiency checks shall be less than three standard deviations of normal operating conditions, unless specified in the SDG's DQOs.

5.4.2 Evaluation

Review the efficiency checks and verify that the frequency requirements were met and that all results were within method specified control limits.

5.4.3 Action

If efficiency QC criteria were not met, qualify all associated positive sample results as estimated (J) and non-detects as estimated (UJ). Results may be qualified as unusable based on direction given by the cognizant technical representative or the SDG's DQOs. Results not meeting frequency criteria and control limits must be clearly documented.

5.5 Background Checks

Background radiation from sources other than the sample (that is, environmental radioactivity, radioactivity in the detector itself or electronic noise) are isolated and accounted for by measuring a simulated sample or source. The sample or source is identical to the actual sample except for the absence of radioactivity from a sample source.

5.5.1 Criteria

Background checks must be acquired for each detector system on a regular basis. The frequency of background checks depends on the sample count time.

Count Time	Background Frequency
0-1 hour	1 per 8 hours
1-8 hours	1 per 24 hours
> 8 hours	1 per week

The background checks should not deviate more than three times the standard deviation of normal operating conditions.

5.5.2 Evaluation

Review the background checks and verify that the frequency and QC criteria were met.

5.5.3 Action

If background check frequency or QC criteria were not met, qualify all positive results as (J) and all undetected results as (UJ). Results may be qualified as unusable based on direction given by the cognizant technical representative or the SDG's DQOs. Results not meeting frequency criteria and control limits applied must be clearly documented.

5.6 Preparation Blanks

Assessment of preparation blank analysis results provides information on the existence and magnitude of any laboratory contamination problems. Evaluation criteria apply to any blank associated with the SDG.

5.6.1 Criteria

No contaminants should be detected in the blank(s).

5.6.2 Evaluation

Review the Preparation Blank data for evidence of blank contamination.

5.6.3 Action

If unsuitable concentrations of contaminants were found in the preparation blanks, qualify associated positive sample data as estimated (J) and (UJ) estimated for non-detects. Results may be qualified as unusable based on direction given by the cognizant technical representative or the SDG's DQOs. Results not meeting criteria must be clearly documented.

5.7 Matrix Spikes/Tracers/Carriers

Matrix spikes, tracers, and carriers are used in radiochemical analysis to determine the accuracy and/or yield for a chemical separation process (not necessary for total beta or gamma energy analysis). All spikes, tracers, and carriers should be of the highest quality and if possible traceable to National Institute of Standards and Technology (NIST).

5.7.1 Criteria

A matrix spike, carrier, or tracer must be analyzed with each sample or as designated in the SDG DQOs. All matrix spikes shall be prepared at .5 to 2 times the concentration of the sample being spiked or as designated in the SDG's DQOs. Recoveries must be within the method or DQOs specified control limits. Control limits of less than three standard deviations of normal operating conditions shall be applied in the case where no control limits are specified.

5.7.2 Evaluation

Review the matrix spike, tracer, or carrier results to verify that the QC requirements were met. Observe any trends in bias that may be present for recoveries that are outside the QC limits.

5.7.3 Action

If recoveries are out of the specified control limits, qualify associated sample data as estimated (J) for positive results and (UJ) for non-detects. Results may be qualified as unusable based on direction given by the cognizant technical representative or the SDG's DQOs. Document the percent recovery (%R) and the control limits applied for all compounds outside those limits and indicate any bias observed in the results. Percent recovery is a calculation of the difference between the spiked sample result and the sample result divided by the spike amount, multiplied by 100.

5.8 Duplicate Analyses

Duplicate analyses provide an indication of laboratory precision based on sample matrix.

5.8.1 Criteria

Duplicate analysis must be performed with every analytical batch or every twenty samples of a batch, or as specified in the SOW or the SDG's DQOs. Method or program DQOs specified control limits shall be applied to the relative percent difference (RPD) where they exist, otherwise the limit shall be less than three standard deviations of the normal operating conditions. If either the sample or duplicate results are below the method detection limit (MDL), then no control limit applies. When calculating the RPD, a value of zero must be substituted for the sample or the duplicate if the value is less than the MDL in either case.

5.8.2 Evaluation

Review the duplicate analysis results to verify that all RPDs fell within the control limits where applicable.

5.8.3 Action

If duplicate analysis RPDs are outside the specified control limits, qualify all associated positive sample results as estimated (J), and non-detects as estimated (UJ). Document the RPD and limits for those compounds out of control.

5.9 Laboratory Control Samples

The Laboratory Control Sample (LCS) is a monitor of the overall performance of an analytical method in all steps of the analysis, including sample preparation. An exception exists for radionuclides where isotope quantities may not be available, in which case the LCS starts with the isotope separation rather than the dissolution.

5.9.1 Criteria

An LCS must be analyzed with each sample batch or as required in the SDG's DQOs. All LCS recoveries must be within the control limits outlined in the program DQOs or within three times the standard deviation of normal operating conditions for all sample matrices if no control limits are specified.

5.9.2 Evaluation

Review the LCS results to verify that the QC criteria were met.

5.9.3 Action

Qualify associated sample results as estimated (J for positive results, UJ for non-detects) for the cases where the LCS were outside control limits. Results may be qualified as unusable based on direction given by the cognizant technical representative or the SDG's DQOs.

5.10 Other Quality Control Checks

Other QC gives the data reviewer the opportunity to review any additional criteria, which may be required by a specific method or the program for which the data is collected. It will also provide any additional documentation that may be applicable to a particular sample or SDG and helpful to future data users. It shall be used for the reviewer to express comments on the overall data quality for an SDG.

Other areas that may be addressed under other QC include, but are not limited to, documentation of the following:

- Alpha and beta sensitivity
- Beta purity
- Plateau and operating voltages
- Counting error statements
- Field duplicates contained in SDG
- Field blanks contained in SDG
- Anomalies associated with calculations or dilutions performed
- Trends observed in the performance of an instrument, method or the laboratory over the course of the SDG or past history
- Anomalies associated with the Chain-of-Custody documentation
- Anomalies associated with shipment or receipt of samples.

It is left to the discretion of the reviewer to evaluate the nature of any problems observed and to attach any qualification that may be necessary to describe the quality of the data. All anomalies and any action taken must be clearly documented.

6.0 DOCUMENTATION REQUIREMENTS

The High Level Radiochemical Validation documentation page consists of the SMO High Level Radiochemical Validation cover sheet, supplemental QC attachment pages, sample Chain of Custody and all sample data. One documentation package is completed for each sample or delivery group.

The Data Assessment Summary section of the cover sheet should be filled out using the O, X, and M codes provided. This form must be initialed and dated by the reviewer upon completion.

The High Level Radiochemical QC attachment pages are used to identify the magnitude and extent of any problems highlighted in the Data Assessment Summary section of the cover sheet. Documentation must include the nature of the problem as well as specific sample numbers or compounds affected by the problem, and any data qualification which results. If additional qualifiers other than those specified in Appendix B of this document are necessary to describe the data, they must be clearly documented and explained.

Any data qualification documented on the High Level Radiochemical QC pages must be compiled and documented on a photocopy of the applicable analytical data report. No writing shall be done on any original data. Each data sheet on which data qualifiers were added must be initialed and dated by the reviewer, and maintained with the rest of the High Level Radiochemical documentation package.

When completed, the High Level Radiochemical Documentation Package for the SDG must be filed and placed in storage in accordance with Section 3.16, "Data Package Control Requirements and Procedure."

7.0 RECORDS

Any records generated as a result of activities described in this section will be managed in accordance with applicable Records Inventory and Disposition Schedules.

8.0 DESIGNATED REVIEWERS

Designated Reviewing Organizations	POC
Sample Management Office (Champion)	K. N. Pool
Analytical Manager	J. R. Prilucik
Quality Systems	J. E. Hyatt

9.0 REFERENCES

EPA, 1977, *Handbook for Analytical Quality Control in Radioanalytical Laboratories*, EPA 600/7-77-088, U.S. Environmental Protection Agency, Washington, D.C. (August).

EPA, 1984, *Eastern Environmental Radiation Facility, Radiochemistry Procedure Manual*, EPA 520/5-84-006, U.S. Environmental Protection Agency, Washington, D.C. (August).

Appendix A. Data Qualifier Definitions

The following qualifiers are applied to the data as a result of the radiochemical validation process and override any previous flags reported by the laboratory. If any other qualifiers are necessary to describe the quality of the data, they must be clearly documented.

Qualifier	Definition
U	The material was analyzed for, but was not detected. The associated value is the MDL.
UJ	The material was analyzed for, but was not detected. The MDL is an estimated quantity.
J	The associated value is an estimated quantity.
R	The data are unusable.

Appendix B. SMO High Level Radiochemical Data Assessment

DATE _____ SAMPLES/MATRIX _____ _____ _____

REVIEWED BY _____ _____ _____ _____

LABORATORY _____ _____ _____ _____

CASE # _____ _____ _____ _____

SDG # _____ _____ _____ _____

DATA ASSESSMENT SUMMARY

QUALITY CONTROL CHECK	ANALYSIS		
1. Chain of Custody			
2. Initial Calibrations			
3. Efficiency Checks			
4. Background Checks			
5. Preparation Blanks			
6. MS/Tracers/Carriers			
7. Duplicate Analyses			
8. LCS			
9. Other			

O = data had no problems
X = data qualified due to minor problem
M = data qualified due to major problems/some data may be unusable

OVERALL ASSESSMENT: _____

_____

_____

NOTES: _____

_____

* Refer to the corresponding attachments for explanation of any problems.

Appendix C. High Level Radiochemical QC - COC

Name _____ Date _____

COMMENTS: _____

_____

_____

_____

ACTION: _____

_____

_____

Sample # Constituent Value/Qual	Sample # Constituent Value/Qual

Appendix D. High Level Radiochemical QC - Initial Calibration

Name _____ Date _____

COMMENTS: _____

_____

_____

_____

ACTION: _____

_____

_____

Sample # Constituent Value/Qual	Sample # Constituent Value/Qual

Appendix E. High Level Radiochemical QC - Efficiency Checks

Name _____ Date _____

COMMENTS: _____

_____

_____

_____

ACTION: _____

_____

_____

Sample # Constituent Value/Qual	Sample # Constituent Value/Qual

Appendix F. High Level Radiochemical QC - Preparation Blanks

Name _____ Date _____

COMMENTS: _____

_____

_____

_____

ACTION: _____

_____

_____

Sample #	Constituent	Value/Qual	Sample #	Constituent	Value/Qual

Appendix G. High Level Radiochemical QC - Matrix Spikes/Tracers/Carriers

Name _____ Date _____

COMMENTS: _____

_____

_____

_____

ACTION: _____

_____

_____

Sample # Constituent Value/Qual	Sample # Constituent Value/Qual

Appendix H. High Level Radiochemical QC - Duplicate Analysis

Name _____ Date _____

COMMENTS: _____

_____

_____

_____

ACTION: _____

_____

_____

Sample #	Constituent	Value/Qual	Sample #	Constituent	Value/Qual

Appendix I. High Level Radiochemical QC - Laboratory Control Samples

Name _____ Date _____

COMMENTS: _____

_____

_____

_____

ACTION: _____

_____

_____

Sample #	Constituent	Value/Qual	Sample #	Constituent	Value/Qual

Appendix J. High Level Radiochemical QC - Other Quality Control

Name _____ Date _____

COMMENTS: _____

_____

_____

_____

ACTION: _____

_____

_____

Sample # Constituent Value/Qual	Sample # Constituent Value/Qual

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222-S Equipment and Piping Labeling

Approved by
A. G. King, Manager
Hanford Analytical Services

Author: T. A. Ryckman
Organization: Laboratory Engineering

1.0 PURPOSE

The purpose of this procedure is to implement and maintain standardized and consistent labeling requirements for equipment and piping in the 222-S Laboratory Complex. Implementation of this procedure will aid facility personnel in the operation and maintenance of the facility (including turnover of construction work) by ensuring immediate and positive identification of equipment and piping. This program follows the guidelines in DOE Order 5480.19, *Conduct of Operations Requirements for DOE Facilities*, Chapter 18, "Equipment and Piping Labeling," and WHC-SP-0708, *Westinghouse Hanford Company Conduct of Operations Manual*, Chapter 18, "Equipment and Piping Labeling."

2.0 SCOPE

This procedure must be used for labeling of equipment and piping for which the 222-S Laboratory has operational control. Guidance is provided to standardize the labeling of components at the facility and for replacement of lost or damaged labels. This procedure shall be used for all new design work done for the facility. New design work often requires that new location designators, system numbers, and component abbreviations be added to those already identified. Labeling of active operating equipment should receive priority over labeling of inactive or deactivated equipment.

It is not the intent of this procedure to require replacement of existing plant labels simply to comply with this procedure. However, if the existing labels are deficient (that is, supplemental information is needed) or if new labels are required due to damage or loss, they shall comply with these guidelines. Using this procedure, the cognizant engineer may re-number any component if it clarifies configuration control of the facility.

The labeling schemes for equipment and piping labeling are identified. The schemes presented are a compilation and extension of those started in the past. This information is given for specific components starting with Section 6.2 of this procedure.

The following are not covered by this procedure:

- Radiological Control Labeling - covered per *Hanford Site Radiological Control Manual*, Chapter 2, Part 3, "Posting,"
- Property Management Tagging Requirements - This labeling (that is, WHC, HO, FA,...) is covered in WHC-CM-2-3, *Property Management Manual*, Section 2.1, "Tagging, Marking and Recording Property,"

- Industrial Safety postings. This labeling is covered in 10 CFR 1910.145, "Specifications for Accident Prevention Signs and Tags," (that is, Danger, Warning, Caution, confined spaces, ...)

- Environmental (that is, satellite accumulation area, ...).

- Building/Area Designation. Assigning Building/area numbers is done by Site Planning and is covered in WHC-CM-8-7, *Operations Support Services*, Section 907, "Building Number Assignment and Retirement Requirements".

3.0 DEFINITIONS

component
A specific piece of equipment such as a pump, valve, instrument, door, and so forth.

component number
An alphanumeric identifier that uniquely identifies each equipment piece.

electric devices
Electric components which are generally internal to electrical equipment (for example, circuit breakers, motor contactors, switches, and so forth).

electrical equipment
Major electrical assemblies which provide operator control of the electrical supply. (for example, motor control centers, uninterruptible power supply, panel boards, and so forth).

label
A device used to locally identify equipment and components. The label will include as a minimum the component number, often a description of the component and other useful information.

location
An abbreviation used to designate a building or some subsection within a building.

system name
A name or acronym used in conjunction with the component number.

sequential number
A controlled and assigned sequential number which, with other parts of the component number, result in a unique identifier.

Temporary Identification Tag
A temporary, but official means of identifying a component with the permanent identification number if the official label is not present, has been damaged, or readability is reduced. Where equipment has not yet been given an official number these tags will be used to assign a temporary number. See Section 7.0 for further detail.

4.0 RESPONSIBILITIES

This procedure applies to all personnel involved in the operation or maintenance of equipment and/or facilities at the 222-S Laboratory Complex.

4.1 Operations Manager

The Operations manager is responsible for:

- Providing personnel support to the labeling program
- Ensuring a Plant Labeling Champion exists
- Ensuring this procedure is communicated to plant personnel who operate or maintain equipment in the plant
- Ensuring future projects follow this procedure or have approval for deviations
- Ensuring all projects meet labeling requirements before facility acceptance.

4.2 Shift Managers

Shift managers are responsible for:

- Control and installation of temporary identification tags
- Ensuring all missing, incorrect, or damaged tags have a replacement request submitted or are reported to the systems cognizant engineer or Labeling Champion to determine correct equipment designations
- Approving installation of labels.

4.3 Maintenance Personnel

Maintenance personnel are responsible for:

- Ensuring labels are not removed, damaged, or destroyed during maintenance activities
- Ensuring missing, damaged or incorrect labels found during maintenance activities are reported and replaced.

4.4 System (Cognizant) Engineer

System engineers are responsible for the following:

- Ensuring all projects for which they are responsible meet labeling requirements before facility acceptance
- Ensuring unique identifiers are used and that the field labeling, drawings, procedures and other documents are consistent with the requirements of this procedure
- Initiating action to have facility documentation revised to correct mislabeled equipment/components or to specify labeling requirements for previously unidentified facility equipment/components
- Including labeling requirements in work packages, especially when new equipment or piping is installed.

4.5 All Personnel

All personnel are responsible for:

a. Observing labels during tours, maintenance, or other activities, paying special attention to:

- Labels damaged or missing after maintenance, modifications or construction
- Labels which are no longer securely attached
- Labels with incorrect information
- Labels no longer required.

b. Reporting the deficiency by submitting a written means to identify work needing to be done, or if not sure of label's content, reporting to the system's cognizant engineer or Labeling Champion to determine correct equipment designations prior to submission of a work request.

4.6 Project Engineer/Project Design Engineer

The project engineer/project design engineer is responsible for the following:

- Monitoring and ensuring that all equipment and piping labeling performed by their project complies with this procedure

- Obtaining new system numbers and guidance when equipment not currently covered in this procedure is being installed by the project.

5.0 REQUIREMENTS

Section 6 of this procedure lists typical equipment and piping to be labeled. (Each component group has the information required to produce an attachment method).

- Incorrectly labeled equipment (does not include labels for which additional information would be useful)
- Equipment operated by Operating Procedures over Preventive Maintenance procedures
- Unlabeled equipment over equipment with correct component number but without supplemental information
- In-service equipment over out-of-service equipment.

6.0 EQUIPMENT IDENTIFICATION

The identification system presented in this section is based on existing systems in use at the facility. This section covers the requirements for each equipment type to be labeled or additional information to be added when label is updated. Typical components to be labeled are:

- Valves and dampers
- Instruments and gauges
- Pipes and ventilation ducts
- Major equipment such as pumps, agitators and tanks
- Busses, motor control centers and local power panels, breakers, switches and instrument panels
- Fuse blocks, fuse locations, relays, terminal boards and other components inside electrical panels.
- Room doors
- Emergency equipment such as fire alarms, fire equipment lockers and communications equipment
- Fire protection systems

6.1 General Labeling Guidelines

6.1.1 Information on labels

Equipment labels shall contain the following:

- Component number (minimum)
- Description/special use (optional, unless otherwise required)
- Maximum voltage (optional, unless otherwise required)
- Power source (optional, unless otherwise required)
- Drawing number (optional, unless otherwise required).

6.1.2 Labels not approved for use

The following are not approved methods of labeling:

- Pencil or ink
- Masking tape
- Marking pens
- Embossing tape.

6.1.3 Nomenclature

The source for the alpha code designations is the Instrument Engineering Flow Diagram (IEFD) symbol legend and code, drawing H-2-93456, which utilizes Institute of Electrical and Electronics Engineers (IEEE) standards for abbreviations and symbols.

The component identification number is composed of three (3) or four (4) entry fields providing a unique designation. The first field is for system identification and may contain up to six (6) characters. The second field is for the component functional description code and may contain up to five (5) characters. The third field is used for the sequential system number assigned to the component and may contain up to six (6) characters. The fourth and final field is used for further delineation of a component, if desired, and may contain up to two (2) characters.

Example: CA-CMP-1

CA	=	Compressed air system
CMP	=	Compressor
1	=	Sequential number of the component in the system

Example: SA-RHC-3-3

SA	=	Supply air
RHC	=	Reheat coil
3	=	Sequential number of the component in the system. In this instance, the numeric designation refers to a coil located in fan unit no. 3.
3	=	Numeric designation indicates that this coil is the third in a series within the fan unit.

6.1.4 Placement

Labels must be placed on or near the subject component, without interfering with the component function or the operator's ability to read the label. The label should be orientated so it is easy to read and the component is identified without question. Consider the typical reading distance and height to ensure the label is visible in the chosen location. Adjacent labels should be separated by sufficient space to prevent confusion which could result from combining the information of two or more labels.

Labels will be attached so they are not removed during routine maintenance. Placement should be consistent on similar equipment. Multiple labels should be considered on large equipment or when the primary label is not visible from the location (that is, behind a panel board) where maintenance or calibrations occur.

Labeling of components must include ALARA (radiological and chemical) or industrial safety considerations.

In areas where radiological contamination potential exists, adhesive, hand-painted, or stenciled labels should be used to ease decontamination effort should it be required. This type of label should also be used if the possibility exists for a dislodged or fallen label to plug strainers or drains, enter pumps or cause similar problems.

Where space does not permit placement of all desired information, priority shall be in the following order: component number, description/special use, power supply information, loads supplied.

6.1.5 Installation of labels

The manner in which the label is attached depends on the type of equipment. Types of commonly used fasteners include - chain, steel bead chain, key clips, wire, tie strips, adhesives. Adhesives should be verified to be chemically compatible with the label, component material and the expected environment (chemical and/or thermal). Surface preparation shall be done according to the directions given for the specific adhesive.

6.1.6 Letter size and design

The component number must be the most predominant information on a label. When other information is desired/required on the label the letter size of the supplemental information must be smaller; a size of approximately one half the component name size is recommended. Below are guidelines for lettering.

a. Character Width: character width-to-height ratio for letters should be between 3:5 and 1:1. The width of letters "M" and "W" should be at least 4/5 of the height, and the letter "I" is normally one stroke wide. For numerals, the width-to-height ratio should be 3:5 except the numeral "4," which should be one stroke wider and the numeral "1", which is one stroke wide.

b. Character height: character height should be based on required reading distance, level of illumination, environments, and importance of the label. For large components and buildings the label size should be larger than the preferred size given below. See below for most common viewing distances:

LETTER SIZES

VIEWING DISTANCE	MINIMUM HEIGHT	PREFERRED MIN. HEIGHT
28 Inches[1]	.125 inches	.125 inches
3 feet	.144 inches	.216 inches
4 feet	.192 inches	.288 inches
5 feet	.240 inches	.360 inches
6 feet	.288 inches	.432 inches
10 feet	.480 inches	.720 inches
20 feet	.960 inches	1.44 inches

[1] The normal reading distance from equipment is 28 inches.

c. Character Stroke Width: the stroke width of medium characters should normally be one-sixth to one-seventh of the character height. For bold characters the stroke width is approximately one-fifth.

d. Character Spacing: the minimum space between characters should be one stroke width. The minimum space between words should be the width of one character. The minimum space between lines should be one-half character height.

e. Color reversal: When information is added to signs it is standard sign making practice to color reverse the supplemental information. This information must be no more than one half the component number size. Labels most likely to have this information are those that identify tanks, dampers, nozzles, contents of a tank, a drawing number, and so forth.

f. Letter Style: e: The type which has proven to be most readable is Helvetica or a similar simple block letter. This type is the most readable under a variety of lighting intensities and sizes.

6.1.7 Materials

The label and attaching material must be compatible with their particular application. Things to consider are heat, chemical resistance, and material compatibility with application (for example, chloride-free labels/adhesives will be used on stainless steel equipment).

Only material guaranteed by the manufacturer to withstand the expected environmental (chemical, thermal, and so forth) conditions will be used.

6.1.8 Colors

Labels for general component identification will be a white field with black lettering. Color coding is used to indicate the hazard (that is, valve labels, piping labels, ventilation ducts, annunciator window panels) or type of system (fire system). The color coding will be covered in sections for each component type under the equipment types.

6.1.9 Installation of labels

See Section 7.0.

6.2 Valves

6.2.1 Nomenclature

All valves are identified using the three part number system consisting of system acronym, component acronym and sequential number. For a list of systems, see Appendix A, 222-S Laboratories Master Component Acronym List.

Below are some special cases and how they are labeled at the facility:

- Backflow preventers - Backflow preventers are numbered as a unit at the facility; their isolation valves are numbered as other valves. The test port valves are not numbered
- Pressure reducing valves - The reducing valve and the regulating (pilot) valve are each given their own number
- Pressure relief valves - These valves will be numbered in the same manner as other valves. Pressure relief valves also have metal tags with the previously assigned number, relief pressure, and test date. The valve number will be used on future tags.

6.2.2 Placement

The attachment means will be placed around the valve neck or through a yoke. Attaching labels to the valve handles will be avoided unless the valve will be operated using a reach rod. On steam lines the tags will be hung to prevent contact with uninsulated valve parts or other nearby components.

Valves which will be operated manually by an extension to the valve will be labeled as follows:

- If the valve extension is permanently attached, and only operated by use of the extension, the label is required only on the extension handle
- If valve label on valve handle or body can be easily seen, no additional label will be required
- If the label on the valve cannot be seen clearly because of depth or cover on the pit and the valve extension is attached, a second label on the extension is required for identification where valve will be operated
- If the label on the valve cannot be seen clearly because of depth or cover on the pit and the valve extension is removable, then the valve extension opening will also be labeled

- Chain operated valves should have labels attached at the valve and the chain loop, if main valve label is not clearly visible.

- If the valve may be operated at the valve handle or extended handle and one label cannot be seen clearly from both locations, then a label is required in each location.

6.2.3 Color

The colors of permanent valve labels will be coded to identify characteristic hazards of the contents. Below are the three color categories.

Material inherently hazardous will have labels with a yellow background and black letters. Examples are:

- Chemical solutions
- High temperature (greater than 120 °F)
- High pressure air (greater than 30 psig)
- Flammable or explosive.

Materials of inherently low hazard will have labels with a green background and white letters. Examples are:

- Water - Raw, Sanitary, or Deionized (120 °F)
- Low pressure air (less than 30 psig).

Materials used for fire quenching will have labels with a red background and white letters.

- Water, foam solutions, CO_2, halon, and so forth.

6.2.4 Letter size

One fourth inch (1/4") letters are standard size on valve tags. This may be slightly smaller if required to fit needed information on the labels.

6.2.5 Material

The standard material for valve labels will be two-ply or three-ply, color laminated plastic. Anodized aluminum labels may be used, but are not preferred due to poor color quality compared to plastic labels.

When plastic labels are used in areas with a history of breakage or wind wear, consider aluminum backed plastic labels or etched colored anodized aluminum labels.

No stamped or engraved labels will be used due to the reading difficulty and lack of conformance to the color coding of labels per line hazard.

Labels with the name on both sides should be considered for locations where the valve label is not easily accessible or is in a hazardous location to manipulate. This will increase the probability that the valve name will always be visible.

6.2.6 Motor operated valves

Motor operated valves should also have an informational label attached with source of power and the failure position of valve.

6.3 Dampers

6.3.1 Nomenclature

New dampers or renamed dampers will follow a scheme similar to valves. The name will consist of three or four fields:

1) System

2) Function (that is, FDM for flow damper modulation)

3) A sequential number

4) The fourth and final field is used for further delineation of a component, if desired, and may contain up to two (2) characters.

6.3.2 Placement

The label will be placed near the location of manual operation or where damper adjustment is seen when the adjustment is performed from a remote location.

6.3.3 Color

Labels will be white with black letters. Any description of the damper will use reversed colors (white letters and black background) and be on the bottom of the label.

6.3.4 Letter size

See Step 6.1.6.

6.4 Instruments and Gauges

6.4.1 Nomenclature

Three or four fields are used when labeling instruments and gages.

1) System

2) Function

3) A sequential number

4) The fourth and final field is used for further delineation of a component, if desired, and may contain up to two (2) characters.

Example: S-PI-200

S	=	Steam system
PI	=	Pressure indicator
200	=	Sequential number of the component in the system

6.4.2 Placement

See Step 6.1.4.

6.4.3 Colors

See Step 6.1.8.

6.4.4 Letter size

See Step 6.1.6.

6.5 Piping

Labeling of piping systems shall follow the guidelines in American Standard Scheme for the Identification of Piping Systems, ANSI A13.1.

6.5.1 Nomenclature

Piping labeling will include the system name, legend of contents, and arrow(s) showing flow direction. Abbreviation of legend will only be used if space limitations make it unavoidable. Double arrows will be used if flow may be in either direction. For steam and compressed air systems the nominal operating pressure will be stated.

Legends such as "SPARE" will not be used unless the line has never been used. "Chemical Utility" will only be used for lines used to transfer a variety of chemicals.

6.5.2 Placement

Labels shall be placed near outlets, tees, flanges, valves, areas where there are direction changes or pass through of ceilings, floors or walls. For long runs of pipe, the maximum interval shall be 50 feet.

Exception: where a number of valves, flanges, tees, changes in direction, etc., make labeling each segment impractical, the label spacing may be reduced from each segment as long as labeling allows tracing of lines. Under this exception the preferred location is near valves.

Exception: for fire suppression systems, if the lines are painted red no labels are needed, but arrows are required to identify water source.

See Step 6.1.4 for other requirements.

6.5.3 Colors

Colors for piping labels will be the same as for valves. See Step 6.2.4 for this information.

6.5.4 Letter size

Lettering on line labels will be per the following table:

Outside Diameter of Pipe or Covering inches	Size of letters inches
3/4 to 1 1/4	1/2
1 1/2 to 2	3/4
2 1/2 to 6	1 1/4
8 to 10	2 1/2
over 10	3 1/2

Small diameter lines used as signal lines do not need to be labeled if the line can be traced to a valve or main line. If line must be labeled, then use a label hung or mounted on the line.

6.5.5 Material

See Step 6.1.7.

6.6 Ventilation Ducts

6.6.1 Nomenclature

Duct labels will contain the system and supply or exhaust and an arrow indicating flow direction. Examples are:

K3 SUPPLY

K1 EXHAUST

6.6.2 Placement

Identification shall be placed near outlets, unions, areas where there are direction changes or pass through of ceilings, floors or walls. With long runs, the maximum placement interval shall be 50 feet. Identification shall be placed on the duct so that it can be easily read by an operator's normal viewing position.

6.6.3 Colors

The labels shall be as follows:

- Fresh supply air labels will have a blue background with white letters
- Exhaust air labels will have a yellow background with black letters.

6.6.4 Letter size

Refer to guidance provided in Step 6.5.4 on optimum letter size for typical reading distance.

6.7 Major Equipment Labeling

6.7.1 Nomenclature

Major equipment is identified using a system acronym, an equipment abbreviation, and sequential number. Below is a partial list of equipment abbreviations:

Abbreviation	Equipment
A	Agitator
P	Pump
PA	Pump-agitator
TK	Tank

6.8 Electrical Equipment Identification

6.8.1 Nomenclature

For electrical devices, the component number is composed of three parts: type of device, sublocation and sequential number.

a. Type of device

Type of Device	Nomenclature
Automatic transfer switch	ATS
Control panel	CP
Distribution panel	DP
Disconnect switch	DS
Emergency Light (See Section 6.11)	EL
Fire alarm control panel	FACP
Generator	GEN
Junction box	JBX
Lighting panel	LP
Motor	M
Motor control center	MCC

Type of Device	Nomenclature
Motor controller	MC
Manual transfer switch	MTS
Pull box	PB
Power panel	PP
Standby generator	SG
Static transfer switch	STS
Terminal box	TB
Transformer	TR
Uninterruptible power supply	UPS
Others as identified on drawings	

NOTES:

- **Switch gear identification is assigned by Electrical Utilities.**
- **Where electrical devices are identified on the system P&ID, the identification on the P&ID shall be used throughout the electrical and instrumentation drawings.**

b. Sequential Number

The sequential number will be as follows:

Panels - alpha and numeric
MCCs - numeric

6.8.2 Placement

Refer to Step 6.1.4. (Labels will be placed on or near equipment location.)

6.8.3 Color

White background with black letters or yellow background with black letters.

6.8.4 Letter size

As large as allowed by label.

6.8.5 Material

Refer to Step 6.1.7.

6.8.6 Other information on label

The following information will also be on the label in addition to the component name. Sizing of this supplemental information will be per Step 6.1.6.

- Description
- Maximum voltage
- Power source
- Drawing number

6.9 Electric Device Identification

6.9.1 Nomenclature

Electric device identification is composed of three parts, device identifier, system identifier (optional), and sequential number.

a. Device identifier

Device Identified	Device
ANN	Annunciator
AS	Alarm Switch
BAT	Battery
CB	Circuit Breaker
CT	Current Transformer
EV	Solenoid Valve
FU	Fuse
HS	Hand Switch
HTR	Heater
IL	Indicating Light
K	Relay
KTD	Time Delay Relay
LS	Level Switch

Device Identified	Device
M	Motor Contactor
MOV	Motor Operated Valve
MS	Manual Switch
OL	Overload
PS	Pressure Switch
PT	Potential Transformer
PWR SUP	Power Supply
SS	Selector Switch
SW	Switch
TB	Terminal Block
TR	Transformer
TS	Terminal Strip
Others as required	

NOTE: **Where electric devices are identified on the system P&ID the identification on the P&ID shall be used throughout the electrical and instrumentation drawings.**

b. System number

Where used the system number shall be as identified on the P&ID or the electrical one-line or elementary diagram. System number shall be used where convenient to identify system.

6.9.2 Placement

Refer to Step 6.1.4.

6.9.3 Color

Refer to Step 6.1.8.

6.9.4 Size

Refer to Step 6.1.6.

6.9.5 Material

Refer to Step 6.1.7.

6.10 Panel Boards

a. Panel identification

This will be the name given to the panel per section 6.8, Electrical Equipment Identification.

NOTE: Location of panel may be omitted if wiring is all internal to the building where the panel is located.

b. Circuit number

Number of the circuit per the panel schedule.

6.11 Emergency Lights (Battery Powered)

6.11.1 Nomenclature

Emergency lights shall be identified by "EL" and a sequential number, that is, "EL-77".

6.11.2 Placement

Refer to Section 6.1.4.

6.11.3 Color

The labels will have a white background with red letters.

6.11.4 Letter Size

Refer to Section 6.1.6.

6.11.5 Material

Refer to Section 6.1.7.

6.12 Doors or Door/Room

6.12.1 Nomenclature

The label shall indicate the door number on the bottom with the functional designation on top. Designators are: FD for fire doors, and VCD for ventilation control door. For all

other doors only the door/room number will be on the label. For locations where door numbers are not assigned, but the rooms are numbered, the door will be labeled with the room number. Buildings with only a few doors will use the building number and a sequential designator.

Doors inspected as fire doors are found on Preventive Maintenance Procedure and must be labeled as fire doors or directions.

6.12.2 Placement

The label will be centered near the top of the door or centered on the header just above the door.

6.12.3 Color

Fire doors - Red background and white letters

Ventilation control doors - White background and black letters

Other doors - White background and black letters

6.12.4 Letter size

See 6.1.6.

7.0 MAINTENANCE OF LABELS

7.1 Discovering Inadequate Labels

7.1.1 All plant personnel should report missing, damaged, or incorrect labels. As part of post maintenance testing, and each time an equipment lineup occurs, personnel shall assure labels are in place.

7.1.2 When labels are found damaged, incorrect, or missing, identify the work needing to be done for the work control process and notify the cognizant supervisor.

7.2 Temporary Labels

Temporary labels shall be either of two types; 1) contain the actual component name when it is known (see paragraph 7.2.1), or 2) consist of a sequentially chosen number when the name is not known (see paragraph 7.2.6). Temporary labels of any form may only be written and installed with the approval of the on duty shift manager or other authorized personnel.

7.2.1 When inadequate (missing, damaged, or incorrect) labeling is found, inform the shift manager.

7.2.2 Determine equipment identification using drawings and all unincorporated ECNs, or illustrations in procedures, or sketch from the system engineer/champion.

7.2.3 If the equipment is identified using the above material, the identification is considered a permanent number; then fill out a Temporary Identification Tag (Store stock item, BT-6001-733R using the permanent number. Use "WA/Procedure No." line to list the number of the work control package number which will fabricate and install the new label.

7.2.4 If the component cannot be identified by a permanent number, then fill out a Temporary Identification Tag with a temporary component name or description and open a work request to designate a permanent number and install a permanent tag. Use "WA/Procedure No." line to list the number of the work control package number which will fabricate and install the new label.

NOTE: If the shift manager is unsure of the function and use of the component, the Temporary Identification Tag may not be issued.

7.3 Installing Temporary and Permanent Labels

7.3.1 The cognizant/system engineer or labeling and piping champion ensures labels comply with this procedure and match the design documentation, procedures, and other applicable documents.

7.3.2 The shift manager approves installation of all equipment labels.

7.4 Independent Verification of installed Labels

7.4.1 The installation is verified by a subject matter expert, the cognizant/system engineer, or the labeling champion. When verifying label installation, one of the following is used:

a. Drawings with all unincorporated ECNs,
b. Illustrations in procedures,
c. Sketch from the cognizant/system engineer/champion.

7.4.2 The verifier ensures the label is physically attached to the proper piece of equipment and the method of attaching the label is adequate. Information used and the verifier's signature is added to the J Form for record.

8.0 LABELING OUT-OF-SERVICE EQUIPMENT

Temporary Identification Tags may be used to identify "Out of Service" equipment with the words "Out Of Service" prominently displayed and all other applicable tag sections completed.

9.0 RECORDS

Any records generated as a result of activities described in this section will be managed in accordance with applicable Records Inventory and Disposition Schedules.

10.0 DESIGNATED REVIEWERS

Designated Reviewing Organizations	POC
Laboratory Engineering (Section Champion)	T. A. Ryckman
222-S Operations Manager	J. R. Prilucik
Laboratory Engineering	S. L. Brey
Quality Systems	J. E. Hyatt

11.0 REFERENCES

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Appendix A

222-S Laboratories Master Component Index Acronyms

ACRONYM	COMPONENT
A	ALARM
AHU	AIR HANDLING UNIT
ARSR	WATER HAMMER ARRESTOR
BFD	BUTTERFLY DAMPER
BFP	BACKFLOW PREVENTER
CD	CONTROL DAMPER
CHL	CHILLER
CHWP	CHILLED WATER PUMP
CMPR	COMPRESSOR
CV	CHECK VALVE
D	DAMPER
D	DRYER
DDC	DIRECT DIGITAL CONTROL
DDCP	DIRECT DIGITAL CONTROL PANEL
DCV	DOUBLE CHECK VALVE
DZ	DAMPER OR VANE POSITIONER
EF	EXHAUST FAN
EHC	ELECTRIC DUCT HEATER
ESE	EMERGENCY EYE WASH / SAFETY SHOWER
EHU	ELECTRIC HEATING UNIT
EV	ELECTRIC SOLENOID VALVE
EWH	ELECTRIC WATER HEATER
F	FILTER
FA	FLOW ALARM
FARSR	FLAME ARRESTOR

ACRONYM	COMPONENT
FCU	FAN/COIL UNIT
FCV	FLOW CONTROL VALVE
FE	FLOW ELEMENT
FH	FUME HOOD
FI	FLOW INDICATOR (ROTOMETER)
FS	FLOW SWITCH
HOOD	FUME HOOD
HTR	HEATER
HV	HAND VALVE
HS	HAND SWITCH
HWP	HOT WATER RECIRCULATING PUMP
II	CURRENT INDICATOR
LDE	LEAK DETECTOR ELEMENT
LDS	LEAK/LEVEL, DIFFERENTIAL/DETECTION, SWITCH
LDT	LEAK/LEVEL, DIFFERENTIAL/DETECTION, TRANSMITTER
LDY	LEAK/LEVEL, DIFFERENTIAL/DETECTION, RELAY
LE	LEVEL ELEMENT
LI	LEVEL INDICATOR
LSH	LEAK/LEVEL, SWITCH, HIGH
LSM	LEAK/LEVEL, SWITCH, MEDIUM
LSL	LEAK/LEVEL, SWITCH, LOW
LT	LEVEL TRANSMITTER
LY	LEAK/LEVEL, RELAY
M	MOTOR
MCC	MOTOR CONTROL CENTER
MVD	MANUAL VOLUME DAMPER
P	PUMP

ACRONYM	COMPONENT
PCV	PRESSURE CONTROL VALVE
PDI	DIFFERENTIAL PRESSURE INDICATOR
PDIS	DIFFERENTIAL PRESSURE INDICATOR SWITCH
PDIT	PRESSURE DIFFERENTIAL INDICATING TRANSMITTER
PDS	DIFFERENTIAL PRESSURE SWITCH
PDSH	PRESSURE, DIFFERENTIAL, SWITCH, HIGH
PDT	DIFFERENTIAL PRESSURE TRANSMITTER
PE	PRESSURE ELEMENT
PI	PRESSURE INDICATOR / VACUUM INDICATOR
PLBD	PANELBOARD
PNL	PANEL
PR	PRESSURE REGULATOR
PRV	PRESSURE REDUCING/REGULATING VALVE
PS	PRESSURE SWITCH
PSV	PRESSURE SAFETY VALVE
REF	REFRIGERATOR
RF	RETURN FAN
RPBP	REDUCED PRESSURE BACKFLOW PREVENTER
RTD	RESISTIVE TEMPERATURE DEVICE
RV	RELIEF VALVE
SF	SUPPLY FAN
SRV	SAFETY RELIEF VALVE
SV	SOLENOID VALVE
SWGR	SWITCHGEAR
T	TRANSFORMER
TC	TEMPERATURE CONTROLLER
TCV	TEMPERATURE CONTROL VALVE

ACRONYM	COMPONENT
TE	TEMPERATURE ELEMENT (PROBE)
TI	TEMPERATURE INDICATOR
TK	TANK
TR	TEMPERATURE RECORDER
TT	TEMPERATURE TRANSMITTER
UPS	UNINTERRUPTIBLE POWER SUPPLY
UR	MULTIVARIBLE, RELAY
V	VALVE
VAC	VACUUM (CLEANER)
YL	EVENT LIGHT
VRV	VACUUM RELIEF VALVE
ZLH	POSITION LIMITER HIGH
ZLL	POSITION LIMITER LOW
ZS	POSITION SWITCH (LIMIT SWITCH)
ZSH	POSITION SWITCH HIGH
ZSL	POSITION SWITCH LOW

ACRONYM	SYSTEM
AC	ACETYLENE
AR	ARGON
BLDG	MISCELLANEOUS BUILDING SYSTEMS
CA	COMPRESSED AIR
CD	CHEMICAL (CONTAMINATED) DRAIN
CHW	CHILLED WATER
CHWR	CHILLED WATER RETURN
CHWS	CHILLED WATER SUPPLY
CNDS	CONDENSATE
CW	COLD WATER
DEW	DEIONIZED WATER
DI	DEMINERALIZED WATER
ES	ELECTRICAL SUPPLY
FP	FIRE PROTECTION
H	HYDROGEN
HE	HELIUM
HPA	HIGH PURITY AIR
HVAC	HEATING, VENTILATION AND AIR CONDITIONING
HW	HOT WATER
IA	INSTRUMENT AIR
LE	LABORATORY EQUIPMENT
M	METHANE
N	NITROGEN
NO	NITROUS OXIDE
OX	OXYGEN
P10	P10 GAS (ARGON/METHANE)
PA	PROCESS AIR

ACRONYM	SYSTEM
PHE	HIGH PURITY HELIUM
PN	PURE NITROGEN
PSD	PERSONNEL SURVEY DEVICE
PW	PROCESS WATER
PV	PROCESS VACUUM
RBW	RETENTION BASIN WASTE
RFW	RAW FIRE WATER
SDS	SANITARY DRAIN SYSTEM
SM	STACK MONITOR
SSAMP	STEAM SAMPLE STORAGE
SW	SANITARY WATER
V	VENT
VAS	VACUUM AIR SAMPLING
WT	WASTE TRANSFER